December 29, 2015

William Teuscher
Idaho Department of Environmental Quality
900 N. Skyline, Suite B
Idaho Falls, ID 83402

RE: Ammonia discharge issues, Driggs' POTW

Dear Willie,

In preparation for our meeting on the 7th of January, the following has been assembled so as to provide some history. This is done because of the problems that have existed at the new Teton Valley Water Reclamation Facility in meeting ammonia discharge limits.

Process Selection: In the summer / fall of 2008, a pilot project was done to show that the Aquarius system called Multistage Aerated Biological Process (MSABP), would work on the wastewater that was currently entering Driggs' wastewater ponds. After several months of testing and purposely overloading the system to four times the typical flow, we found that it was able to meet BOD, TSS, and ammonia limits anticipated in the discharge permit for the facility to be constructed. Ammonia was non-detect most of the time and we felt that there should be no problems meeting the anticipated permit levels. We did see TSS creep up as flows increased however so we decided to add a clarifier and filter on the back end of the system. We have attached the piloting information as reference. It is interesting to note how much stronger the influent is now as compared to when the pilot was run.

Interim Period: It should be noted that not long after the pilot and during the design period, the lagoon system started to have very bad odors. They already were having compliance issues for many years.. We attributed the odors to further problems with the fine bubble diffuser system and with the floating aerators not working correctly all the time. However, we now believe that even then, something toxic was hitting the facility and killing the biological treatment system within the lagoons. Besides the terrible odors that were developing there was also floating sludge in the ponds. Everyone felt that we just need to get the new plant on line and all would be well. We did not want to spend a lot of time and money trying to fix the old facility. In hindsight, we now feel that something toxic was starting to be discharged and was killing the biological treatment system within the two aerated lagoons.

New Plant Startup: The new plant was started up in October of 2013. At first, the BOD and TSS were very low and the ammonia was in the low single digits. We were all excited as to how quickly the system was working well and felt we were on our way. We did not see anything toxic happening in the system at that time. However, as the winter came on, and water temperatures dropped very low and the ammonia levels started to rise. Initially, the inhibition was attributed to cold water temperatures and discussions were started to try to fix the problem of freezing laterals in the city wherein water would be turned on in houses to prevent freezing. Very cold spring water, shallow laterals, and a shallow collection system all contributed to the water temperatures dropping quickly. As this in turn was causing very cold water to hit the plant we tried to mitigate it by seeding the plant with biosolids from the Rexburg facility. However, as spring came and water temperatures came up, the treatment system was not only having problems with ammonia, but also with BOD and TSS at times. The biology in the different cells was odorous, was floating, and was not consistent with the pilot and other facilities visited prior to construction. It was also noted that the system seemed to get a little better on weekends and then would go bad by mid-week.

Investigation: Over the past two years, the City of Driggs and AQUA have been investigating the problems plaguing the treatment facility. The following issues were raised and discussed as follows:

1. **The MSABP Process**: The process is quite simple in that there are 2 trains, each with 12 cells that have stationary media on which fixed film bacteria can grow. In the bottom of these cells are fine bubble diffusers to supply oxygen. It is classified as a submerged fixed film, aerated process. This is opposed to above ground fixed film processes such as trickling filters or rotating biological contactors. Bacteria simply attach to the media and reduce the organic and nitrogenous material as it passes from cell to cell suspended in the water. The detention time at the 1 mgd design flow rate is 24 hours. So with the flow rate presently seen of just under 500,000 gpd average, there is over 48 hours detention time. In other MSABP processes, the media looks dark in the first few cells, lighter in the middle cells, and clean the last few cells. This is because "bugs" eat food at first cells, bugs eat food and other bugs in the middle cells, and at the end, bugs are just eating bugs. At Driggs, the media has been a gray color all the way through all the cells. The odors generated, while not near as bad as the lagoon system in the past, are still consistent with the pungent odor smelled before, regardless of the dissolved oxygen level.

   The MSABP process is very simple and there are not many things that can be changed to affect the process itself. One can vary the air and can vary the recycle. Both have been varied a lot and have had temporary effects on the system but in the end, the cells still did not look like other facilities and the ammonia discharge remained high. AQUA and the City have worked closely with Aquarius, but it is felt that there is nothing wrong with the process itself. We believe that there is just something toxic being discharged to the treatment facility. Perhaps the cold water temperatures in the winter are worsening the toxicity, but since ammonia reduction is not happening in warmer months either, it is felt that the process itself is not the blame. An effort to turn it into an activated sludge process by recycling the sludge from the bottom of the clarifier showed no improvement in ammonia reduction. Recycling some pond water from cell 2 seemed to mysteriously improve the ammonia reduction. We honestly cannot explain that phenomenon other than possibly seeding with a nitrifying bacteria on a constant basis that is growing in the second pond and is acclimated to the toxicity.

2. **Industrial Users:** The influent BOD and Ammonia are very high considering the amount of I&I in the system. BOD's in the 400's mg/l have been seen whereas it would be expected to see BOD's in the 150's. Ammonia's have been seen in the 30's whereas they should be in the high teens. The high BOD can be explained by the discharge from a micro-brewery called Wildlife Brewing in Victor. There is also a second smaller brewery called Grand Teton Brewing Company. Influent from Victor is always high in BOD. However, even with the higher BOD and higher than normal ammonia, the MSABP process should have no problem reducing these loads to permit levels. Sampling has been done to try to locate where higher loads have been coming from and to date, the brewery in Victor is the only place that has been found. Testing for pH, ORP, and grabbing COD samples have been run throughout the collection system and nothing was found that would indicate a caustic or acidic cleaner was causing the issue. At the headworks, there are no odors or anything that would suggest that a "cleaner" is causing the problem. We have attached a summary of the testing data from the collection system.

3. **Miscellaneous Issues**: There have been several problems in the plant besides the toxic flow as follows:

   a. **Dirty Power.** The biggest issue that has been encountered at the plant has been the dirty power from Falls Electric. Just this last week there were four power outages and one brownout where power dropped to 40 volts coming in. The city has purchased some used standby generators, but switching back and forth is not immediate and you still have a lag. Many changes have been made to try to mitigate the poor power being supplied to the facility. This poor power problem is something that we are continuing to work on.

   b. **Screen Problems**. Another issue was the blinding of the screens and also problems with their controls. We have worked with the supplier and seem to have the blinding issue fixed by having the main line into the headworks scour each day. The line was filling with "grain" that is coming from the brewery. Since VFD's control the pumps, they were not scouring the line daily. The supplier also fixed the controls issue that was causing the screens to shut down.

c. **High Speed Blowers.** Much work has been done to keep the blowers running properly. The dirty power does not help as high speed turbine blowers need to stay on and not cycle. K-Turbo was purchased by Aerzen of Germany and they have tried to fix the controls of the blowers so that they will come back on automatically when there is a power problem. The blowers have been a lot of maintenance.

d. **Algae in Clarifier**. Algae growing in the clarifier has been mitigated by covering the clarifier.

e. **Disc Filter.** The disc filter supplier had told us that chlorine would not be needed to keep it clean. However, the filter is blinding off from a bacterial growth that is like a clear gel and when this happens, the filter has to be bypassed when it is cleaned manually. To protect the non-potable or utility water system in the plant when this happens, a filter has been ordered to install right after the utility water pumps.

The City has put together a pretreatment program and submitted it to Victor giving Driggs the authority to inspect, sample, and require changes to industrial users to prevent the problems at the treatment plant. The issue however is that to date, we are not sure what is causing the toxicity. As can be seen in the pilot work, ammonia was basically non-detect in every sample. This is consistent with this type of treatment, a fixed film, well aerated system. It is the reason that it was chosen. If were just the higher strength flow that has happened since the pilot work was done, the treatment system should be able to handle it. However, there is something besides the higher strength.

Sincerely,

L. Scott Rogers, P.E.
Principle, AQUA Engineering

CC: City of Driggs

4.2 Aquarius MSABP Pilot Project in Driggs Idaho

A pilot facility utilizing MSABP technology was installed in June of 2008. This system consisted of a 12 stage bioreactor and was designed to treat a small portion of screened influent from the main WRF. Sample influent and effluent data were taken from the pilot plant to determine the efficiency and effectiveness of the technology for treating wastewater from the Driggs, Idaho area. The retention time was varied throughout the pilot project to help determine optimal sizes and storage times for a full-size plant. Selected photographs of the pilot plant are shown in Figure 4-2.

Figure 4-2: Images from MSABP pilot plant. Top Left – blowers and main holding tank of pilot equipment. Top Right & Bottom Left – Inside individual MSABP basins or stages, showing wastewater and fabricated inner carrier for bacteria. Bottom Right – Effluent form pilot plant flowing into WWTP lagoon.

4.2.1 Pilot Project Data

Several parameters were monitored from June 10 through November 6, 2008 at the pilot project, including influent and effluent BOD, TSS, ammonia, turbidity, and temperature. These parameters were measured to determine the real world efficiency of the MSABP technology. The retention time in the pilot tanks was varied from 24 hours at the beginning, to 8 hours during the middle, and finally reduced to 6 hours near the end of pilot to help correlate retention time and treatment efficiency, and to help in sizing a full-scale system. A complete set of data measured at the pilot plant is provided in the appendix.

4.2.2 Pilot Plant BOD

Influent and effluent BOD data show that the MSABP pilot plant averaged 92% BOD_5 removal over the entire data set. Influent BOD concentrations averaged 230 mg/L and effluent concentrations averaged 18 mg/L (Figure 4-3). Note that effluent BOD increases during the second half of the pilot program. This is related to the retention time and shows that longer retention times produce better effluent. With retention time is at 24 hours, BOD removal efficiency averages 96.2%, and effluent BOD averages 14 mg/L. Figure 4-4 shows the relationship between retention time and BOD removal efficiency. The retention time was decreased mainly to tests the ultimate fail limits of thc technology, which proved to be two to three times the rated hydraulic and organic design capacity.

Even with a retention time of 8 hours, BOD removal efficiency is fairly high (94.8%), but drops to 89% at 6 hours retention time. Thus, concerning BOD, it appears that a minimum of 8 hours is needed to keep BOD removal around 95% using MSABP technology. Obviously, the longer the retention time, the higher the BOD removal percentage, but this minimum retention time should be considered in designing the full-scale MSABP plant.

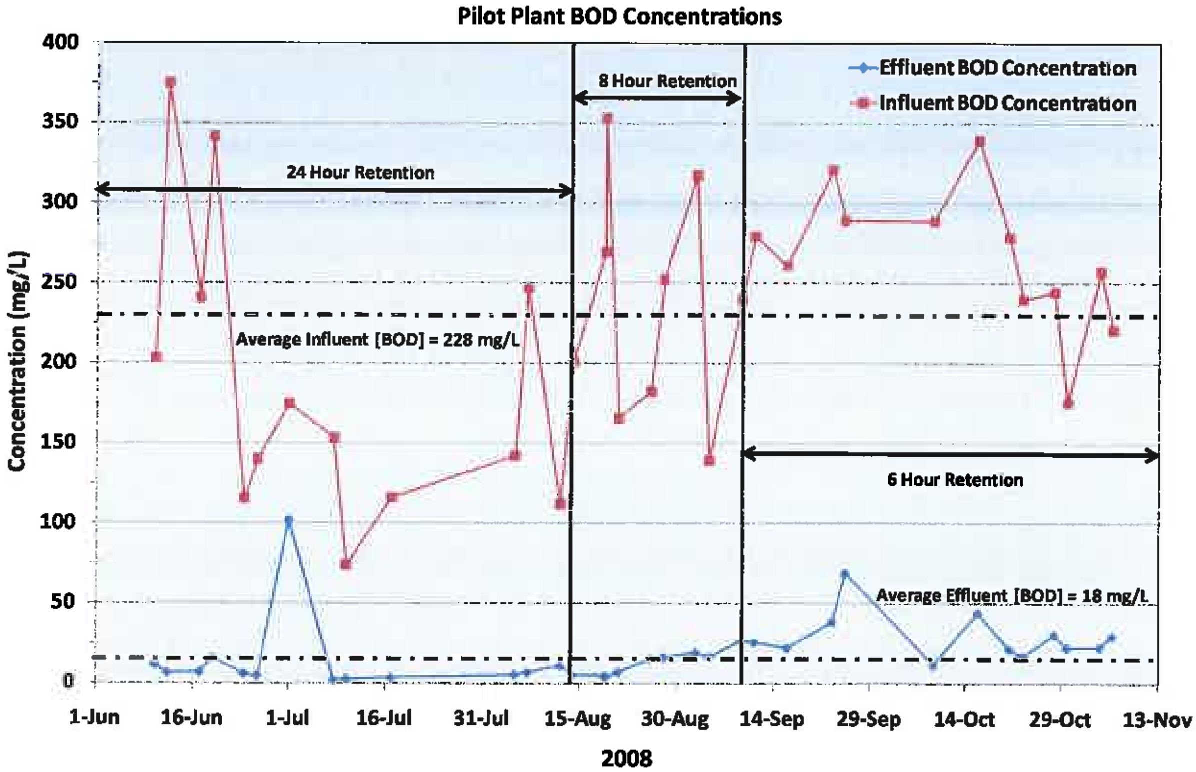


Figure 4-3: Pilot plant influent and effluent BOD measurements.

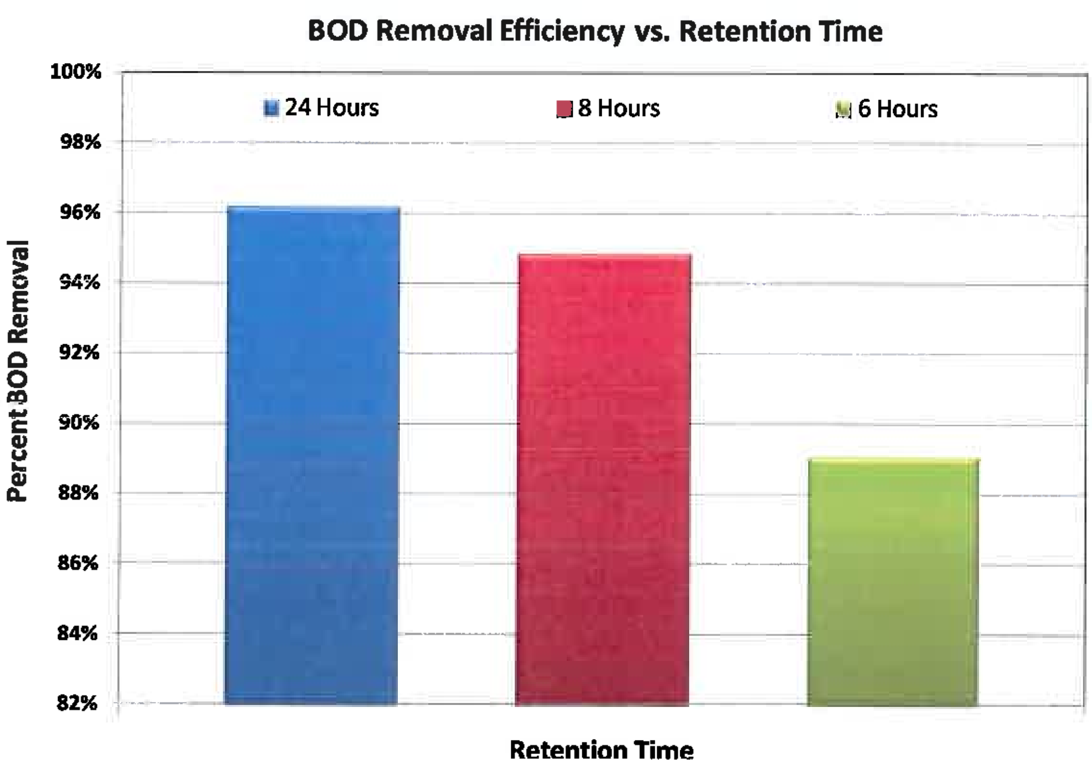


Figure 4-4: Retention time versus BOD removal efficiency (%) at the pilot plant.

4.2.3 Pilot Plant TSS

Influent and effluent TSS data show that the MSABP pilot plant averaged 77% TSS removal over the entire data set. Retention time had a much higher impact on TSS removal than BOD removal. Influent TSS concentrations averaged 180 mg/L (135 mg/L less than values reported from the main WWTP) and effluent concentrations averaged 37 mg/L (Figure 4-5). When the retention time is at 24 hours, TSS removal efficiency averages 95.7%, and effluent TSS averages less than 10 mg/L. Dropping to 8 hours retention time decreases the TSS removal efficiency to 85.7%, and at 6 hours, the efficiency dropped to 59.9% (Figure 4-6).

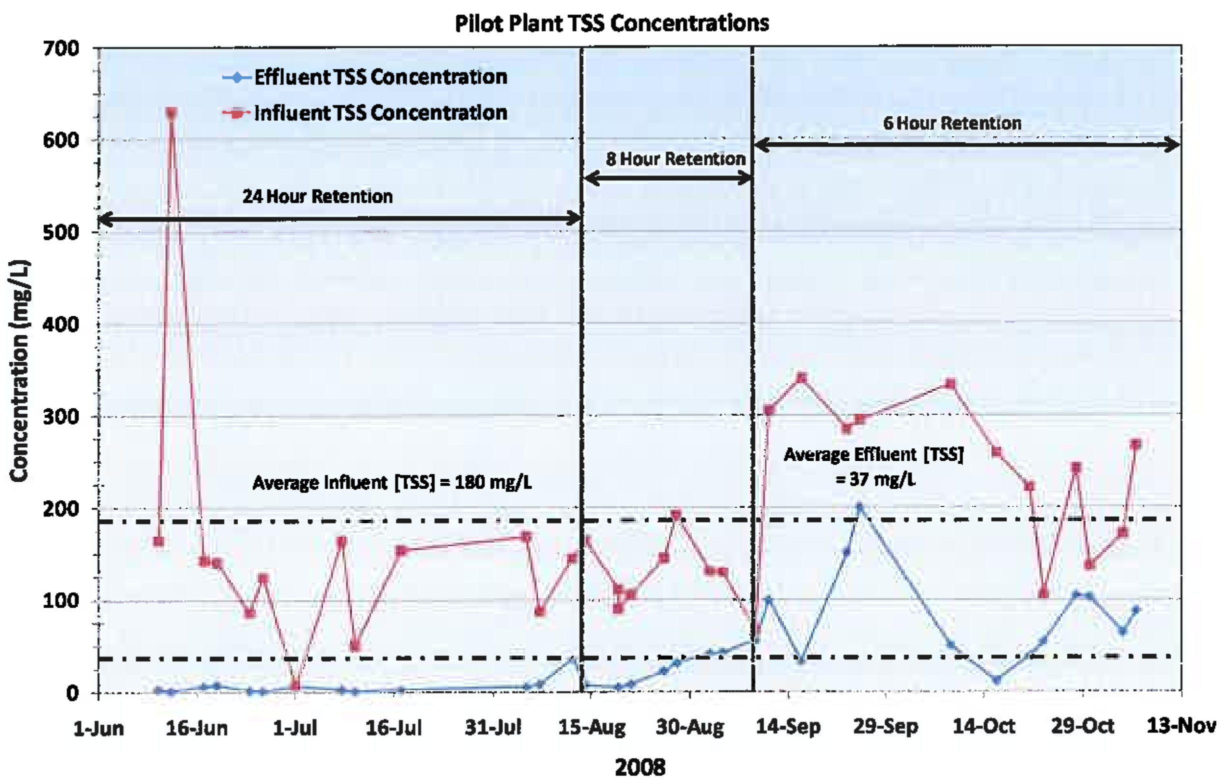


Figure 4-5: Pilot plant influent and effluent TSS measurements.

TSS removal appeared to be more sensitive to the retention time. At 24 hours, the removal efficiency is comparable to that of BOD. However, even at 8 hours, the TSS removal decreases dramatically. Thus, the data suggest that TSS may dictate the size of the full-scale plant, or additional grit removal is needed upstream of the MSABP tanks. This justifies installing a grit trap or fine screening (1mm) as part of the headworks process.

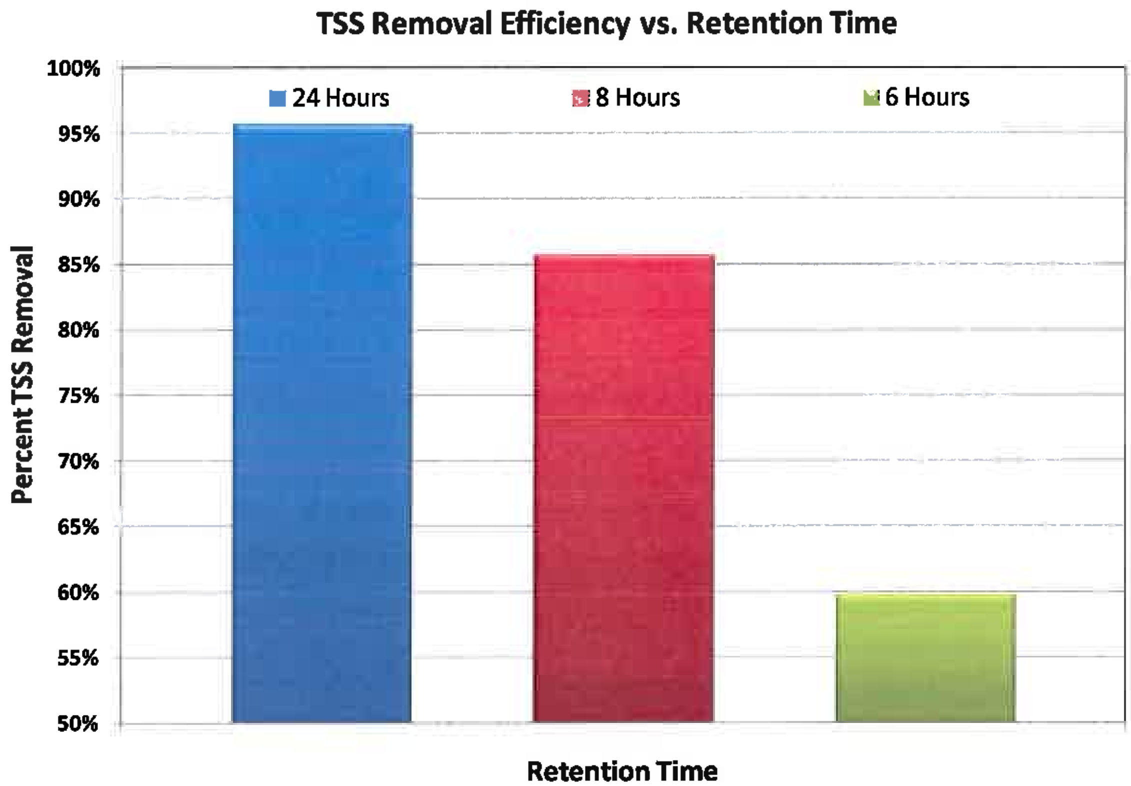


Figure 4-6: Retention time versus TSS removal efficiency (%) at the pilot plant.

4.2.4 Pilot Plant Nitrogen (Ammonia and Nitrate)

The effects of the MSABP plant on nitrogen levels were also monitored during the pilot project. Influent and effluent ammonia (NH_3) and nitrate (NO_3) were measured. However, since influent nitrate and effluent ammonia were negligible (measurements reported at less than 1.0 mg/L, due to the nature of the MSABP process and wastewater treatment in general), only *influent* ammonia and *effluent* nitrate are discussed here. Influent ammonia averaged 31.1 mg/mL, and ranged from 12 mg/L to 43 mg/L (Figure 4-7). Effluent nitrate averaged 12 mg/L, and also appeared to vary with the retention time. Again, longer retention time yielded lower effluent nitrate values.

Removal efficiency of nitrogen requires a direct comparison of the amount of influent and effluent nitrogen. Since ammonia and nitrate have different molecular weights (17 mg/millimole and 62 mg/millimole respectively), the concentrations of ammonia and nitrate cannot be directly

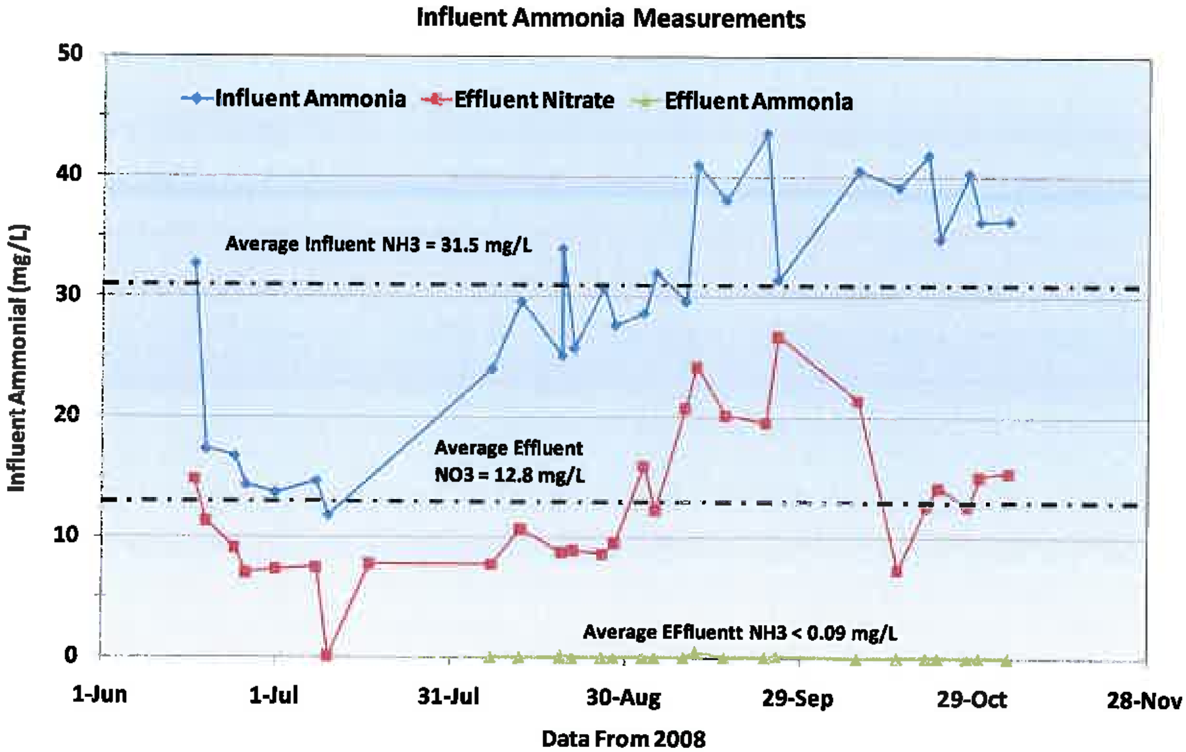


Figure 4-7: Influent ammonia and effluent nitrate measured at the pilot plant.

compared to determine nitrogen removal efficiency. Using the molecular weights, the number of moles of influent and effluent nitrogen is determined to allow for a direct comparison as follows:

$$\frac{Moles\ of\ Nitrogen}{Liter} = \frac{Concentration\ (Ammonia\ or\ Nitrate)}{Molecular\ Weight\ (Ammonia\ or\ Nitrate)}$$

$$\therefore Influent\ \mathrm{N} = \frac{[Ammonia]}{MW_{Ammonia}} = \frac{31.1\ {}^{mg}/_{Liter}}{17\ {}^{mg}/_{millimole}} = 1.829\ \frac{millimoles\ \mathrm{N}}{Liter}\ or\ 25.61\ \frac{mg\ N}{L}$$

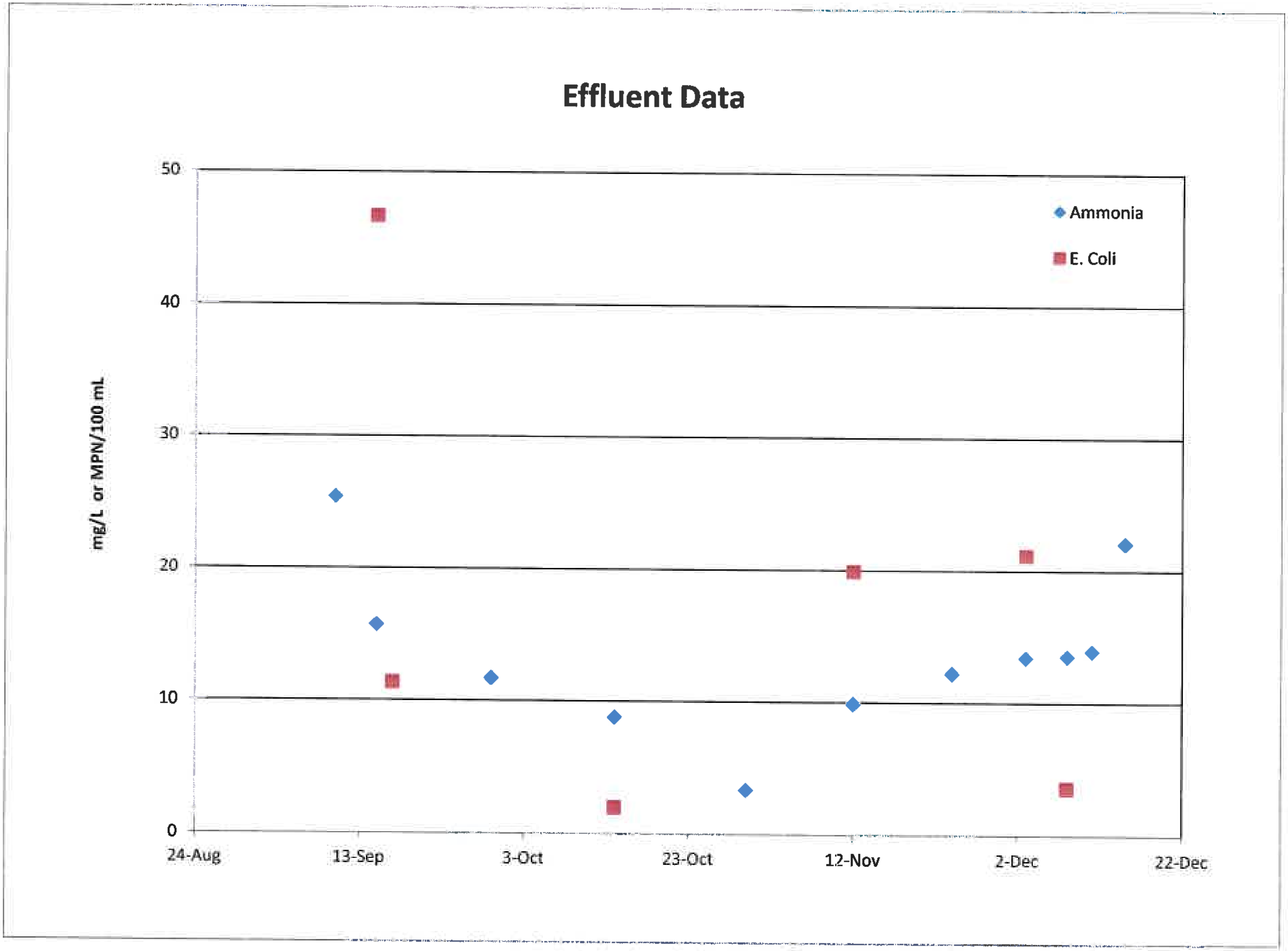
and

$$Effluent\ \mathrm{N} = \frac{[Nitrate]}{MW_{Nitrate}} = \frac{12\ {}^{mg}/_{Liter}}{62\ {}^{mg}/_{millimole}} = 0.194\ \frac{millimoles\ \mathrm{N}}{Liter}\ or\ 2.72\ \frac{mg\ N}{L}$$

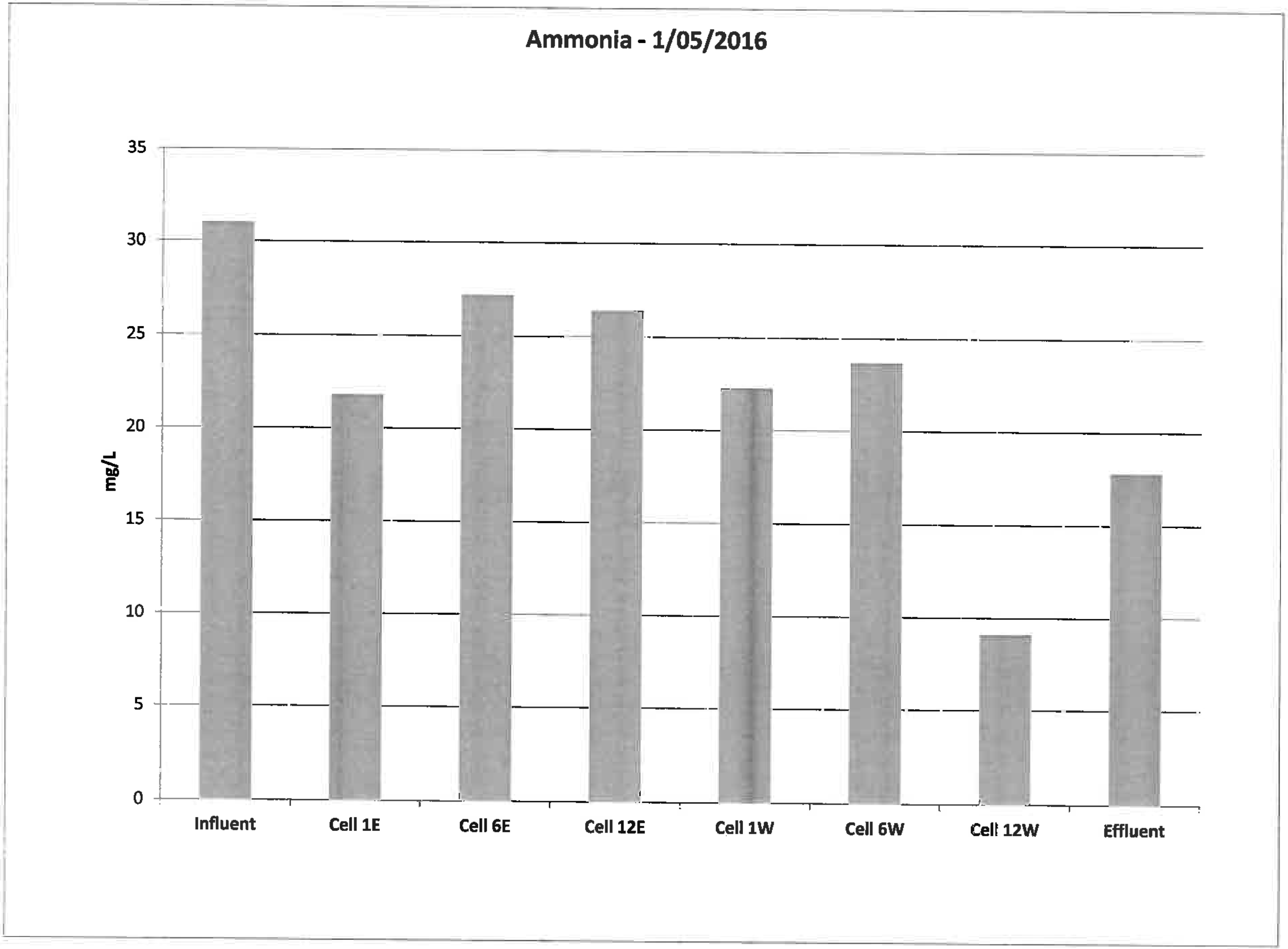
Using these values, the overall average removal efficiency of influent nitrogen is 89.4% at the pilot plant. The removal efficiency is even higher (93+%) with a 24 hours retention time. MSABP technology is superior for ammonia removal, and quickly reduces ammonia concentrations in the waste stream. Even for the pilot study, which had retention times as low as 6 hours, effluent ammonia levels were between 0.05 and 0.1 mg/L. This technology will easily meet the EPA's new effluent ammonia limit of <1.0 mg/L.

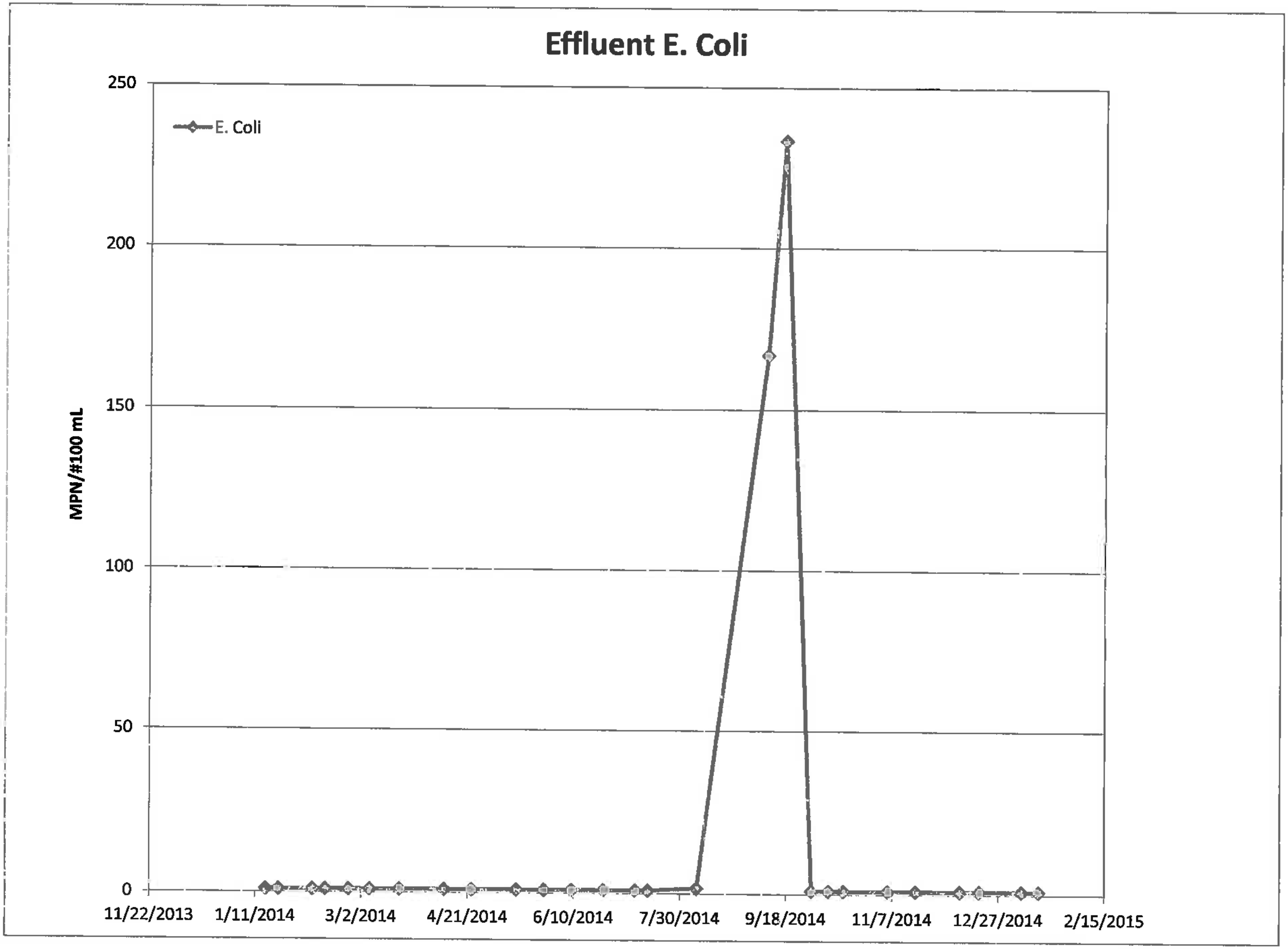
4.2.5 Other Pilot Plant Data

Other parameters monitored at the pilot plant include influent and effluent pH and temperature; ambient temperature of the headworks facility; and dissolved oxygen (DO) levels of pilot plant water samples versus removal time and temperature. All of these parameters showed reasonable levels and were close to comparable measurements taken from the main WRF flow stream. The data collected from the pilot plant is provided in the appendix.

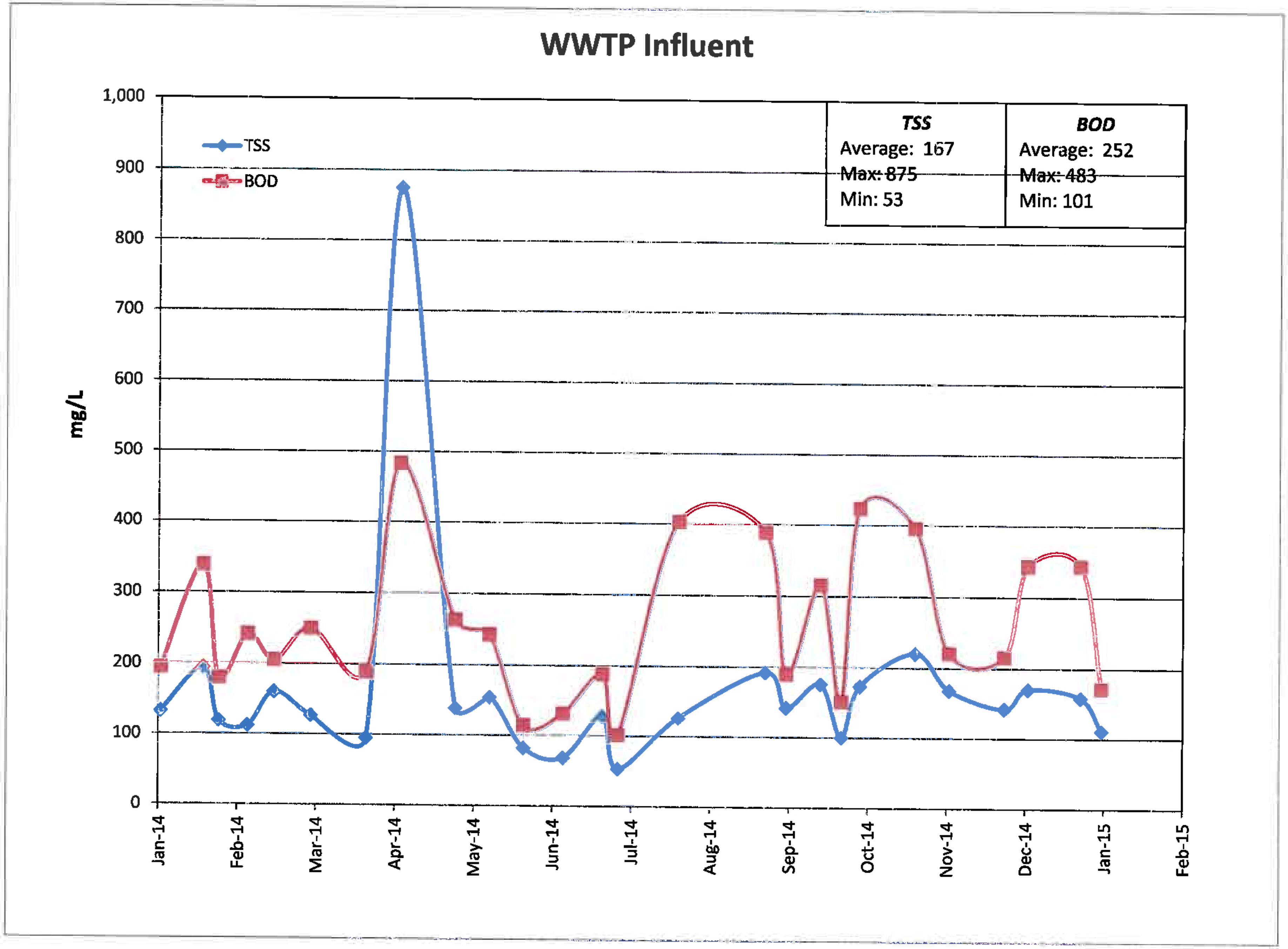


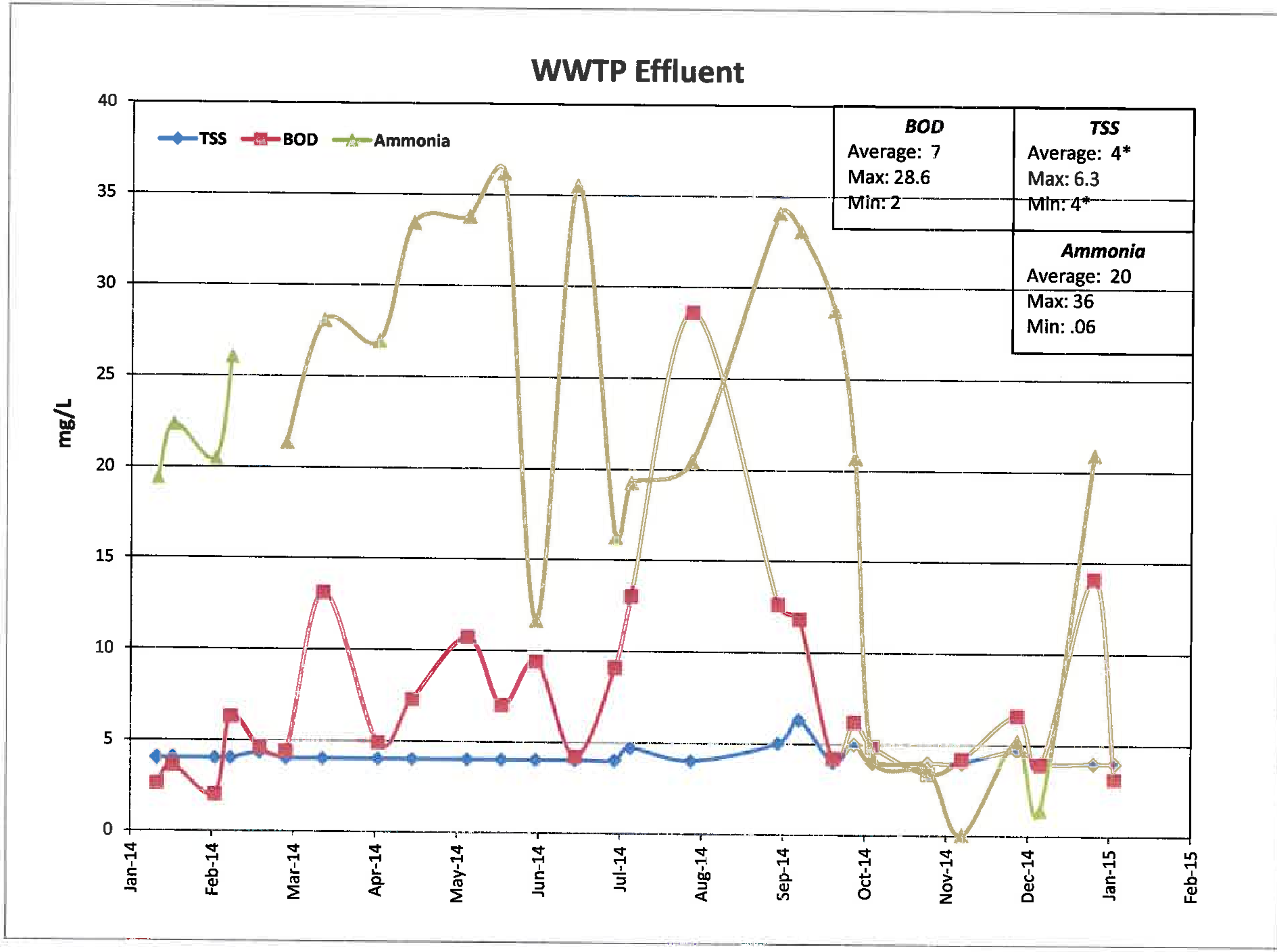
Effluent Data
mg/L or MPN/100 mL
50
40
30
20
10
0
24-Aug
13-Sep
3-Oct
23-Oct
12-Nov
2-Dec
22-Dec
Ammonia
E. Coli


Ammonia - 1/05/2016
mg/L
35
30
25
20
15
10
5
0
Influent
Cell 1E
Cell 6E
Cell 12E
Cell 1W
Cell 6W
Cell 12W
Effluent



Effluent E. Coli
E. Coli
MPN/#100 mL
250
200
150
100
50
0
11/22/2013
1/11/2014
3/2/2014
4/21/2014
6/10/2014
7/30/2014
9/18/2014
11/7/2014
12/27/2014
2/15/2015


WWTP Influent
mg/L
1,000
900
800
700
600
500
400
300
200
100
0
TSS
BOD
TSS
Average: 167
Max: 875
Min: 53
BOD
Average: 252
Max: 483
Min: 101
Jan-14
Feb-14
Mar-14
Apr-14
May-14
Jun-14
Jul-14
Aug-14
Sep-14
Oct-14
Nov-14
Dec-14
Jan-15
Feb-15


WWTP Effluent
mg/L
0
5
10
15
20
25
30
35
40
TSS
BOD
Ammonia
BOD
Average: 7
Max: 28.6
Min: 2
TSS
Average: 4*
Max: 6.3
Min: 4*
Ammonia
Average: 20
Max: 36
Min: .06
Jan-14
Feb-14
Mar-14
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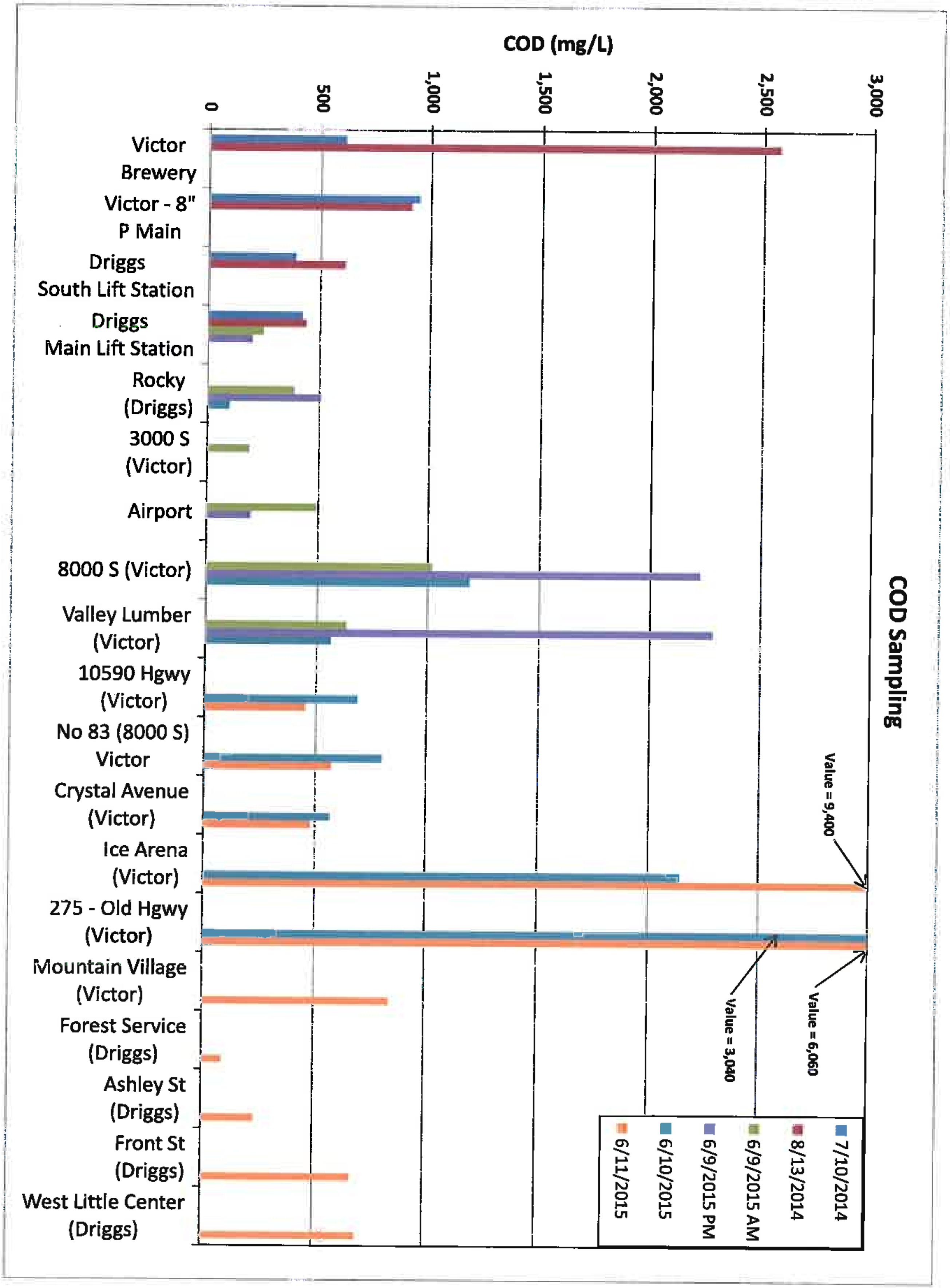
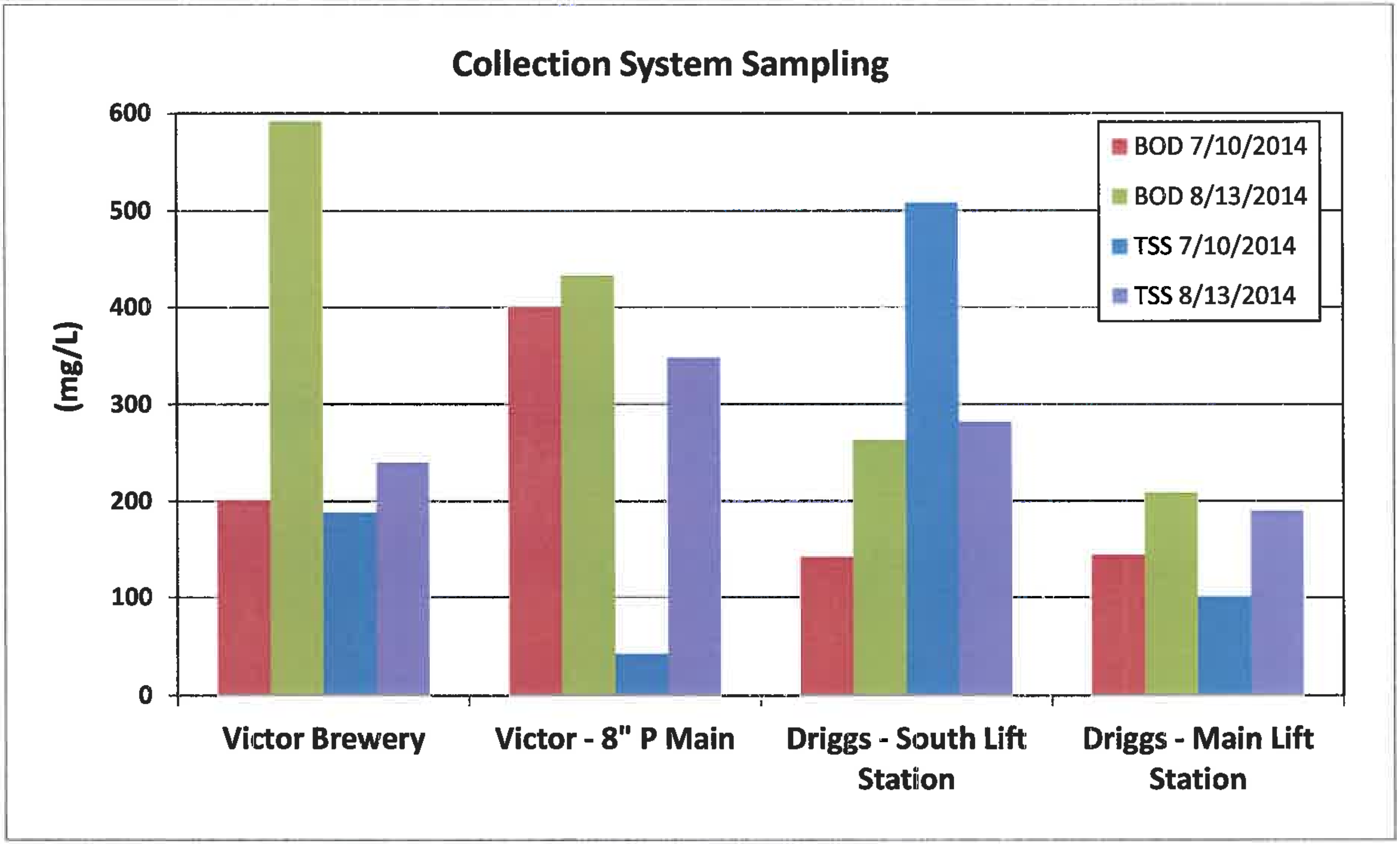
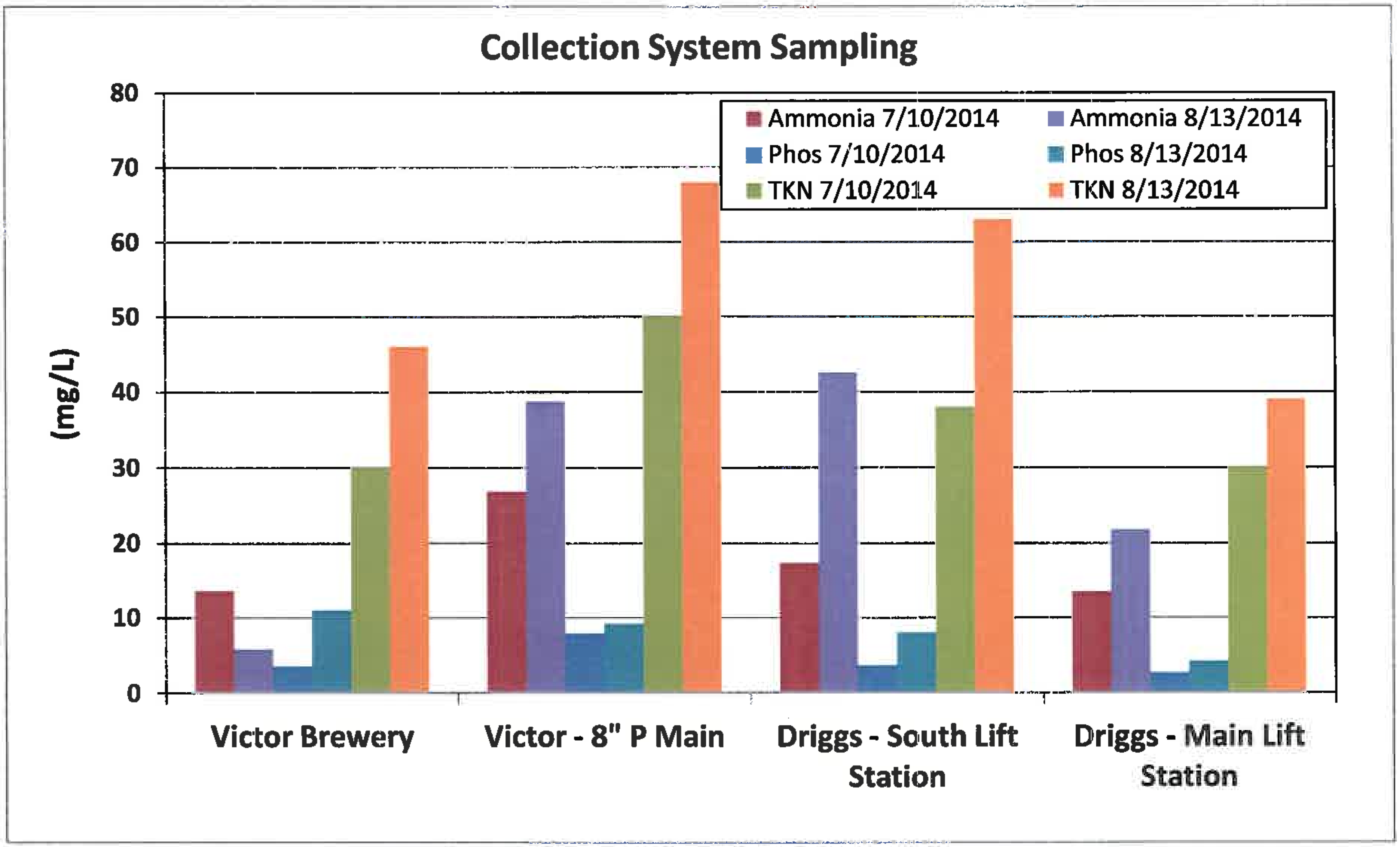
Jun-14
Jul-14
Aug-14
Sep-14
Oct-14
Nov-14
Dec-14
Jan-15
Feb-15


COD Sampling
COD (mg/L)
0
500
1,000
1,500
2,000
2,500
3,000
Victor Brewery
Victor - 8" P Main
Driggs South Lift Station
Driggs Main Lift Station
Rocky (Driggs)
3000 S (Victor)
Airport
8000 S (Victor)
Valley Lumber (Victor)
10590 Hgwy (Victor)
No 83 (8000 S) Victor
Crystal Avenue (Victor)
Ice Arena (Victor)
275 - Old Hgwy (Victor)
Mountain Village (Victor)
Forest Service (Driggs)
Ashley St (Driggs)
Front St (Driggs)
West Little Center (Driggs)
Value = 9,400
Value = 3,040
Value = 6,060
7/10/2014
8/13/2014
6/9/2015 AM
6/9/2015 PM
6/10/2015
6/11/2015


Collection System Sampling
(mg/L)
600
500
400
300
200
100
0
BOD 7/10/2014
BOD 8/13/2014
TSS 7/10/2014
TSS 8/13/2014
Victor Brewery
Victor - 8" P Main
Driggs - South Lift Station
Driggs - Main Lift Station



Collection System Sampling
(mg/L)
80
70
60
50
40
30
20
10
0
Ammonia 7/10/2014
Ammonia 8/13/2014
Phos 7/10/2014
Phos 8/13/2014
TKN 7/10/2014
TKN 8/13/2014
Victor Brewery
Victor - 8" P Main
Driggs - South Lift Station
Driggs - Main Lift Station